

VALENTINA MAZZOTTI

📍 Montréal, Québec

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PROFILE

Experimental physicist currently completing an MSc at McGill University, with hands-on experience operating ultrafast laser systems and developing Python-based experimental control and analysis tools. My work combines quantum materials experiments with computational modeling (DFT, machine learning, Monte Carlo simulations), allowing me to move between theory, simulation, and the laboratory. I am particularly interested in how precise experimental systems and robust software design come together to enable new quantum technologies.

RESEARCH & WORK EXPERIENCE

01/2026 – ongoing

RESEARCH INTERN
Erlangen, Germany

Applied AI & Device Modelling Group

- Developing Physics-Informed Neural Networks (PINNs) to simulate material- and device-level processes relevant to battery systems, embedding physical constraints directly into the model architecture to improve stability and extrapolation beyond the training data.
- Investigating separable and factorized neural network architectures to address high-dimensional input spaces and reduce computational complexity.
- Designing hybrid computational workflows that combine classical numerical methods and quantum algorithms to evaluate electronic and structural properties of cathode materials for battery applications.

09/2024 – ongoing

RESEARCH ASSISTANT

McGill University - Montréal, QC

Ultrafast THz Spectroscopy Laboratory – Prof. Dr. David G. Cooke

- Investigate polaron formation and charge-carrier dynamics in halide perovskites and cerium oxide using ultrabroadband time-resolved terahertz spectroscopy.
- Align, calibrate, and maintain an ultrabroadband THz-TDS and TRTS system based on a sub-50 fs Ti:Sapphire laser, synchronizing optical pump-probe paths via motorized delay stages to achieve sub-picosecond temporal resolution.
- Perform lock-in based signal acquisition and implement Python routines for Fourier analysis, complex conductivity extraction, and model fitting (Drude / Drude-Smith).
- Analyze how carrier scattering and polaron formation influence mobility, connecting experimental observables to microscopic transport mechanisms.
- Troubleshoot timing instability, mechanical drift, and detector noise to ensure that the measurements are stable and reproducible.
- Align, calibrate, and maintain an ultrabroadband THz-TDS and TRTS system based on a sub-50 fs Ti:Sapphire laser.
- Synchronize optical pump-probe paths using motorized delay stages to achieve sub-picosecond temporal resolution.
- Perform lock-in amplifier based signal acquisition and implement Python routines for Fourier analysis and conductivity extraction.
- Diagnose and correct timing instability, mechanical drift, and detector noise to ensure reproducible measurements.

10/2023 – 08/2024

RESEARCH ASSISTANT

Stewart Blusson Quantum Matter Institute – UBC

Quantum Materials Laboratory – Prof. Dr. Alannah Hallas

- Performed density functional theory (DFT) simulations on high-performance computing (HPC) clusters to model structural and magnetic properties of perovskite materials.
- Developed a computational workflow integrating DFT, Wannierization, and linear-response calculations to extract effective interaction parameters.
- Managed parallel simulation jobs and analyzed large electronic structure datasets to identify stability trends and microscopic structure–property relationships in these classes of materials.

12/2021 – 05/2024

ENERGY SYSTEM DESIGNER & SOFTWARE DEVELOPER

Sustaingineering – UBC

Member of the Electrical and Software Team of Sustaingineering, which is an Engineering Design Team at UBC with the goal of motivating students to act on global sustainability issues through technology.

- Designed and assembled a hybrid renewable energy system for the Sustainable Mobile Research Testbed (SMRT) project, incorporating solar panels, batteries, and control components to create an off-grid mobile home.
- Developed a web application for remote monitoring, capturing data for real-time monitoring of a water pump system in Nicaragua.

05/2023 – 08/2023

SUMMER RESEARCH ASSISTANT

Stewart Blusson Quantum Matter Institute – Vancouver, BC

Computational Quantum Materials Laboratory – Prof. Dr. Alannah Hallas

- Developed data-driven models to predict properties of high-entropy materials using machine learning techniques.
- Applied cluster expansion methods combined with ML to derive effective energy models.
- Implemented Monte Carlo simulations in Python to study finite-temperature behavior.

05/2022 – 09/2022

SUMMER RESEARCH ASSISTANT

Max-Planck-Institute for Solid State Research – Stuttgart, Germany

Ultrafast Solid State Spectroscopy / – Prof. Dr. Stefan Kaiser

- Built, aligned, and optimized pump-probe and pump-pump-probe setups for ultrafast spectroscopy experiments on quantum materials.
- Calibrated timing, synchronization, and signal integrity across laser, detector, and electronic subsystems.
- Rewrote lock-in amplifier control software from LabVIEW to Python, improving automation, reproducibility, and hardware-software integration.

05/2021 – 09/2021

RESEARCH ASSISTANT AND SOFTWARE DEVELOPER

Stewart Blusson Quantum Matter Institute - Vancouver, BC

Member of the ARPES (Angle-resolved photoemission spectroscopy) group under the supervision of Dr. Andrea Damascelli; the lab focuses on studying the structural, electronic, and magnetic properties of novel complex systems and nanostructured materials.

- Developed a Python-based GUI to control and track micrometer-scale sample positioning inside an ARPES chamber.
- Implemented coordinate tracking and movement logging to improve reproducibility of laser-based photoemission measurements.
- Collaborated with hardware engineers to integrate positioning feedback into the spectrometer control workflow.

05/2019 – 06/2019

INTERNSHIP AT IBM

IBM Studios - Milan, Italy

- Information session about the IT world, Cognitive computing and Big Data.
- Creation of a Chatbot using Watson Assistant on the IBM Bluemix platform.

EDUCATION

09/2024 – 08/2026

McGill University – Montréal, Canada

Master of Science

Physics (Thesis)

Relevant coursework: Nonlinear Optics, Advanced Condensed Matter Physics, Statistical Mechanics

09/2020 – 05/2024

University of British Columbia – Vancouver, Canada

Bachelor of Science

Combined Honours in Physics and Computer Science

Relevant coursework: Algorithms & Data Structures, Advanced Machine Learning, Numerical Methods, Software Engineering, Linear Algebra, Probability

LANGUAGES

Italian, German - Fluent

English - Proficient (C2)

French - Advanced (C1)

Mandarin - Beginner

DIGITAL & TECHNICAL SKILLS

Experimental Systems: Ultrafast laser alignment, pump-probe synchronization, delay stage control, lock-in detection, hardware-software integration

Programming & Scripting: Python, C++, C, Java, Julia, MATLAB, Bash (Linux)

Machine Learning & AI: PyTorch, TensorFlow, Hugging Face, Physics-Informed Neural Networks, Model Training & Validation

Scientific Computing: Numerical Methods, Data Analysis, Optimization, Monte Carlo Simulations

Electronic Structure & Modeling: VASP, Quantum ESPRESSO, Wannier90

High-Performance Computing: Linux environments, job scheduling, parallel workflows

Web & Application Development: Python-based GUIs, Node.js (Back-End), HTML, CSS, JavaScript

Data Visualization & UI Tools: Matplotlib, Figma, Canva

Engineering & Prototyping: Arduino, AutoCAD, SolidWorks

VOLUNTEERING & EXTRACURRICULAR ACTIVITIES

08/2024 – current	Physics Public Talks and Social Media Coordinator McGill University - Montréal, Canada Currently organizing public talks for the Department of Physics, including speaker recruitment, venue setup, and event promotion. I am also responsible for creating and managing content for social media, highlighting research and advertising department wide events, as well as being part of the EDI and the Outreach Committee of the Department of Physics.
01/2025 – current	Student Member, RQMP Community RQMP – Montréal, Canada Currently involved in organizing the RQMP Summer School on Advanced Materials, a multidisciplinary event that brings together graduate students and researchers across Quebec to promote collaboration and knowledge in materials science.
2025 – Present	Volunteer Program Coordinator – Springbay Studio Remote / Montreal, Canada Support in organizing educational activities for children focused on climate change and biodiversity. Contributed to the development of interactive content and event logistics aimed at engaging youth with sustainability and environmental science.
06/2023 – 10/2023	Marketing Director for the Q-SITE Conference Q-SITE (Quantum – Science, Information, Technology, and Engineering) Conference As Marketing Director for Canada's first student-led undergraduate quantum conference, held simultaneously at UBC and the University of Toronto, I led the promotion of the event, which focused on quantum information science and its multidisciplinary applications. I managed the conference website and all social media platforms
10/2021 – 12/2023	Social Media Lead of the SAC Student Council of the Canadian Association of Physicists (SAC) Organized student-focused events such as problem-solving competitions, hackathons, and lecture series. I managed social media content, including a monthly journal series on breakthrough discoveries in physics.

PUBLICATIONS

V. Mazzotti, S. S. Aamlid, A. A. Mancilla, J. Machts, M. Rutherford, J. Rottler, K. M. Kojima, and A. M. Hallas, *Origin and scarcity of breathing pyrochlore lattices in spinel oxides*, *Phys. Rev. Mater.* **9**(3), 033602 (2025), DOI: 10.1103/PhysRevMaterials.9.033602.

L. Feng, J. Cao, T. Priessnitz, Y. Dai, T. Oliveira, J. Yuan, R. Oka, M.-J. Kim, M. Chen, A. Ponomaryov, I. Illyakov, H. Zhang, Y. Lv, V. Mazzotti, G. Kim, G. Christiani, G. Logvenov, D. Wu, Y. Huang, and H. Chu, *Dynamical interplay between superconductivity and charge density waves: A nonlinear terahertz study of coherently driven ${}_2\text{H}-\text{NbSe}_2$* , *Phys. Rev. B* **108**, L100504 (2023), DOI: 10.1103/PhysRevB.108.L100504.

S. K. Y. Dufresne, S. Zhdanovich, M. Michiardi, B. G. Guislain, M. Zonno, V. Mazzotti, L. O'Brien, S. Kung, G. Levy, A. K. Mills, F. Boschini, D. J. Jones, and A. Damascelli, *A versatile laser-based apparatus for time-resolved ARPES with micro-scale spatial resolution*, *Rev. Sci. Instrum.* **95**(3), 033907 (2024), DOI: 10.1063/5.0176170.